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A summary of the Foundation Research Program : report period 1 October 1981 to 30 September 1982.

Naval Postgraduate School (U.S.)

Monterey, California. Naval Postgraduate School

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NAVAL POSTGRADUATE SCHOOL

Monterey, California

A SUMMARY OF THE

FOUNDATION RESEARCH PROGRAM

March 1983

Report for the Period

1 October 1981 to 30 September 1982

Approved for Public Release; distribution unlimited

Prepared for:
Office of Naval Research
Arlington, Virginia 22217

Chief of Naval Development
Washington, D.C. 20360

NAVAL POSTGRADUATE SCHOOL
Monterey, California

Rear Admiral John J. Ekelund

David A. Schrady
Provost

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Behavioral Examination	Cybernetic Models	Fatigue of Alloys
Careerist Retention	Synoptic Studies	Jet-Crossflow

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*:

Forty-six projects of Independent Research/Independent Exploratory Development were funded by the NPS Foundation Research Program. This research was in the areas of Computer Science, Mathematics, Administrative Sciences, Operations Research, National Security Affairs, Physics, Electrical Engineering, Meteorology, Aeronautics, Oceanography and Mechanical Engineering. A tabulation in Appendix I identifies area of research and the investigator(s). The category of independent research or independent exploratory research is also identified for each research task.

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OVERVIEW OF THE NPS FOUNDATION RESEARCH PROGRAM FY 1982

The principal thrust of the research and exploratory development program at the Naval Postgraduate School (NPS) stems from its mission:

> To conduct and direct advanced education of commissioned officers, and to provide such other technical and professional instruction as may be prescribed to meet the needs of the Naval Service; and in support of the foregoing to foster and encourage a program of research in order to sustain academic excellence.

A portion of the research performed at NPS is conducted through grants from the Chief of Naval Research and the Chief of Naval Development. Together these funds provide the basis for the NPS Foundation Research Program.

The major objectives of the Foundation Research Program are four-fold and include:

* sponsoring research efforts of junior faculty enabling them to establish a strong research program in their chosen field,
* allowing experienced faculty to change the course of their research programs,
* increasing the general research capability of the Naval Postgraduate School through capital equipment procurement, and
* providing the opportunity for the fulfillment of meritorious research projects that have no sponsor.

The four objectives are pursued with the ultimate goal of stimulating the highest quality research program at NPS in support of the educational program received by students.

The Foundation Research Program is administered internally by a Research Council comprised of selected faculty members and chaired by the Dean of Research. The function of the Research Council is to properly implement the goals and objectives of the program with a view toward approving meritorious proposals submitted by the NPS faculty.

This report describes the accomplishments of the Foundation Research Program for FY 1982. The summaries of the research efforts are organized by academic departments. Some research efforts have been funded by the Chief of Naval Research (6.1) which are oriented toward initiating and conducting scientific and applied research of a long-range nature in areas of special interest to the Navy. Other efforts have been funded by the Chief of Naval Development (6.2) and are used for conducting exploratory development deriving from scientific program areas or in other areas specifically requested by the Navy.

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DEPARTMENT

OF

COMPUTER SCIENCE

Title: Distributed vs. Centralized Database Systems

Investigator: Dushan Z. Badal, Associate Professor of Computer Science

Sponsor: NPS Foundation Research Program

Objective: The purpose of this investigation was to analyze the impact of concurrency control on transaction execution cost and system performance in centralized and distributed data base management systems based on long haul and local area networks.

Summary: The purpose of this research is twofold. First, we investigate the impact of concurrency control on transaction execution cost and system throughput in centralized and distributed data base systems (DBS) based on slow and fast (local) networks. Second, we show that in terms of transaction execution cost and DBS throughput there are some applications for which any distributed DBS can be more effective than any centralized DBS and vice versa. We also argue that for other applications the decision in favor of distributed or centralized DBS should be based on the comparison of specific DBS systems.

Publications: D. Z. Badal, "The Effects of Concurrency Control on Centralized DBMS and Distributed DBMS Based on Long Haul and Local Networks," Proceedings of 2nd International Symposium on Distributed Databases, Berlin, Sept. 1-3, 1982.

D. Z. Badal, "Distributed vs. Centralized Database Systems - Transaction Execution Cost and Performance Analysis," NPS Technical Report, NPS52-82-007, July 1982.

Title: Relational Programming

Investigator: Bruce J. MacLennan, Assistant Professor of Computer Science

Sponsor: NPS Foundation Research Program

Objective: Continued development of relational programming as an advanced methodology for software development. Short term objectives include: (1) discovery of the semantic primitives of relational programming, (2) design of a relational programming language, and (3) assessment of the value of relational programming.

Summary: Relational programming is a method of programming based on the use of a relational calculus. It is well known that almost any data structure can be described by a relation. In effect, then, any operation on relations can be thought of as an operation on data structures. Hence, the high-level relational operators provided by a relational calculus are a source of high-level operations for manipulating linear and non-linear data structures.

Further, since every function is a relation, every relational operator is in effect a functional operator, i.e., a function that operates on other functions. Therefore, the same set of operators that are used for manipulating data can also be used for manipulating programs. This permits the high-level combination and manipulating of programs to yield other programs.

Several tasks have been accomplished this year. First, a set of relational operators has been settled on. Second, we have developed two notations for relational programming, one mathematical and one non-mathematical. Third, we have investigated several implementation strategies for relational languages. Fourth, we have tried to assess the value of relational programming by using it to implement a major piece of software (a syntax-directed editor). Finally, we have developed a theoretical basis for accommodating databases and other time-varying objects in relational languages.

Publications: B. J. MacLennan, "Introduction to Relational Programming," Proceedings of ACM Symposium on Functional Programming Languages and Computer Architecture, New York: Association for Computing Machinery, 1981.

B. J. MacLennan, "A Simple, Natural Notation for Applicative Languages," Sigplan Notices 17, 10, October 1982.

B. J. MacLennan, "Values and Objects in Programming Languages," Sigplan Notices, forthcoming.

B. J. MacLennan, "Overview of Relational Programming," NPS Technical Report, NPS52-81-017, November 1981.

B. J. MacLennan, "A Relational Program for a Syntax Directed Editor," NPS Technical Report, NPS52-82-006, April 1982.

B. J. MacLennan, "The Role of Objects in Applicative Languages," NPS Technical Report, in progress.

B. J. MacLennan, "A Simple Production System for Applicative Programming," NPS Technical Report, in progress.

Conference Presentation:

B. J. MacLennan, "Introduction to Relational Programming," ACM Symposium on Functional Programming Languages and Computer Architecture, Portsmouth, New Hampshire, October 18-22, 1981.

Theses Directed:

S. Futaci, "Representation Techniques for Relational Languages and the Worst Cast Asymptotical Time Complexity Behavior of the Related Algorithms," Master's Thesis, June 1982.

O. D. Borcheller and R. Ross, "Functional Pascal: An Interim Solution to a Changing Direction in Programming Language Development," Master's Thesis, June 1982.

Title:	Advanced Work on an Algorithm Design Methodology
Investigator:	Douglas R. Smith, Assistant Professor of Computer Science
Sponsor:	NPS Foundation Research Program
Objective:	To continue the development of a methodology for automatically constructing computer programs.
Summary:	A top-down approach to program synthesis has been developed. This research has involved several supporting activities. 1) investigation of the structure of the class of algorithms called "divide and conquer" resulting in a novel algebraic characterization. 2) formalization and implementation of a new form of deduction called precondition derivation.
Publications:	D. R. Smith, "Derived Preconditions and Their Use in Program Synthesis," 6th Conference on Automated Deduction, Ed. D. W. Loveland, Lecture Notes in Computer Science 138, Springer-Verlag, New York, pp. 172-193. D. R. Smith, "Top-down Synthesis of Simple Divide and Conquer Algorithms," NPS Technical Report, NPS52-82-011TR, November 1982.
Conference Presentation:	D. R. Smith, "Derived Preconditions and Their Use in Program Synthesis," 6th Conference on Automated Deduction, New York, NY, June 1982.

DEPARTMENT

OF

MATHEMATICS

Title: Acceleration of Convergence of Iterative Algorithms

Investigator: Michael D. Humphries, Adjunct Professor of Mathematics

Sponsor: NPS Foundation Research Program

Objective: To find methods of accelerating algorithms that converge superlinearly, to analyze their theoretical properties, and to study their practicality.

Summary: There are many iterative methods for solving nonlinear equations. There is a standard technique for accelerating the rate of convergence of an iterative method that converges linearly (slowly). The most appropriate methods for solving these problems converge faster than linearly. General techniques of accelerating the rate of convergence of iterative methods that converge superlinearly were developed. These techniques were applied to various methods of solving equations, yielding new, more rapid methods. Some of these were already known; the general approach provided a unified framework for them. Others are apparently new; their rates of convergence were determined. They proved to be more efficient than the traditional method in wide use. This was confirmed by experiment with numerical examples.

Publication: Michael D. Humphries, "The Acceleration of Superlinear Convergence", in progress.

Title:	Fundamental Frequencies of Oscillation of an Immersed Elastic Boundary
Investigator:	Raul Mendez, Adjunct Professor of Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	Testing of the Vortex Dipole Algorithm. Estimate fundamental frequencies of oscillation of an immersed elastic boundary. Compare these estimates against those obtained via linearization of equations of motion.
Summary:	Agreement was obtained between computed and predicted frequencies (obtained via linearization) for small amplitudes of the boundary's oscillation, for larger amplitudes the two methods failed to agree. This disagreement was predictable in view of the basic assumptions underlying the linearization.
Publications:	R. Mendez, "Fundamental Frequencies of Oscillation of an Immersed Elastic Boundary," SIAM Journal of Statistics and Scientific Computing, forthcoming. R. Mendez, "Fundamental Frequencies of Oscillation of an Immersed Elastic Boundary," NPS Technical Report, forthcoming.
Conferences Presentation:	R. Mendez, "Fundamental Frequencies of Oscillation of an Immersed Elastic Boundary," preliminary version of this work presented at 1981 SIAM Meeting, Rensselaer Polytechnical Institute, June 6, 1981.

Title:	Numerical Modelling of Transonic Flow Past Cascade Blades Via Higher Order Godunov Methods
Investigator:	Raul Mendez, Adjunct Professor of Mathematics, S. Eidelman, NRC Postdoctoral Research Associate
Sponsor:	NPS Foundation Research Program and Office of Naval Research
Objective:	To develop a numerical scheme capable of simulating flow past cascade blades.
Summary:	Design and testing of a numerical scheme for computing transonic flow past cascade blades. Numerical scheme is based on higher order approximations to the compressible Euler's equations. The scheme is based on Van Leer's monotonicity interpolation scheme as well as on Collela-Woodward's MUSCL scheme.
Publications:	S. Eidelman and R. Mendez, "Numerical Modelling of Transonic Flow Past Cascade Via Higher Order Godunov Methods," Journal of Computational Physics, submitted for publication. S. Eidelman and R. Mendez, "Numerical Modelling of Transonic Flow Past Cascade Via Higher Order Godunov Methods," NPS Technical Report, forthcoming.
Conference Presentation:	S. Eidelman and R. Mendez, "Numerical Modelling of Transonic Flow Past Cascade Via Higher Order Godunov Methods," to be presented at AIAA Meeting, University of California, Davis, May 1983.

Title:	Numerical Solution of The Interior Neumann Problem Via Vortex Dipoles
Investigator:	Raul Mendez, Adjunct Professor Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	Testing of a numerical scheme designed to compute potential flows on irregular regions via tangential vortex dipole layers. The scheme is based on an approximation to a Fredholm integral of the second kind obtained by computing the Neumann sum via discrete vortex dipole layers.
Summary:	The method was tested on an irregular region simulating an aortic sinus cavity. The data for the Neumann problems was generated via Chorin's discrete vortex method. The method succeeded in producing a potential flow that, when superimposed on Chorin's flow, led to no fluid seepage or leakage at the wall.
Publication:	R. Mendez, "Numerical Solution Of The Neumann Problem Via Vortex Dipoles," NPS Technical Report, Forthcoming.
Conference Presentation:	R. Mendez, "Numerical Solution Of The Neumann Problem Via Vortex Dipoles," SIAM National Meeting, North Carolina State University at Raleigh, North Carolina, April 1982.

Title: The Vortex Monopole Algorithm: Representation of Elastic Forces Applied to Incompressible Inviscid Fluids

Investigator: Raul Mendez, Adjunct Professor of Mathematics

Sponsor: NPS Foundation Research Program

Objective: Testing of the Vortex monopole algorithm. Estimate frequency of oscillation of immersed elastic boundary and compare against estimates obtained via vortex dipole algorithm as well as predicted frequencies obtained via linearization. Test new algorithm for computing boundary forces via spline approximation.

Summary: Excellent agreement was obtained between the three methods for small amplitudes of oscillation. The new method, however, requires approximately one third less computer effort per iteration, while simulating the physical properties of the system with improved accuracy.

Publications: R. Mendez, "The Vortex Monopole Algorithm: Representation of Elastic Forces Applied to Incompressible Inviscid Fluids," SIAM Journal of Statistics and Scientific Computing, Submitted for publication.

R. Mendez, "The Vortex Monopole Algorithm: Representation of Elastic Forces Applied to Incompressible Inviscid Fluids," NPS Technical Report, forthcoming.

Conference Presentation: R. Mendez, "The Vortex Monopole Algorithm: Representation of Elastic Forces Applied to Incompressible Inviscid Fluids," SIAM National Meeting, June 1983, Boulder, Colorado.

Title:	Determination of Frequency Dependent Early-To-Reverberant Sound Ratios Using Ray Tracing Methods
Investigator:	J. L. Wayman, Adjunct Professor of Mathematics
Sponsor:	NPS Foundation Research Program
Objective:	To extend earlier work by others on computer prediction of early-to-reverberant sound ratios in rooms to include frequency dependent boundary conditions.
Summary:	The early-to-reverberant sound ratio has been put forth by many researchers as a design index for predicting speech intelligibility in rooms. Computer implemented ray methods can be used to predict these ratios from room specifications. Santon (JASA, Vol. 59, No. 6, 1976) applied the ray model in this manner. This study extended Santon's work by considering the frequency-dependence of the boundary acoustic impedances, and showed that the ray method can be used to predict frequency-dependent early-to-reverberant sound ratios.
Conference Presentation:	J. L. Wayman, "Determination of Frequency Dependent Early-to-Reverberant Sound Ratios in Enclosures", 103rd meeting of the Acoustical Society of America, Chicago, Illinois, 26-30 April 1982.

DEPARTMENT

OF

ADMINISTRATIVE SCIENCES

Title: A Behavioral Examination of Corporate Capital Investment

Investigator: Philip Bromiley, Assistant Professor of Administrative Sciences Department

Sponsor: NPS Foundation Research Program

Objective: To increase our understanding of the determinants of corporate expenditures on property, plant and equipment.

Summary: Based on the interviews and data analysis from four large corporations, research considered the implications of corporate operating procedures on capital investment. Corporate planning and implementation procedures were described, hypotheses concerning the implications of such tested, and a conceptual framework for the determinants of capital investment produced.

Publications:

Philip Bromiley, "The Determinants of Corporate Capital Investment: A Behavioral Approach," in progress.

Philip Bromiley, "Comparison of Behavioral and Neo-Classical Conceptions of Investment," in progress.

Philip Bromiley, "A Summary of 'A Behavioral Investigation of Corporate Capital Investigation,'" in progress.

Conference Presentation: Philip Bromiley, "The Impact of Organizational Processes on Strategic Action: The Capital Investment Decision," submitted to Strategic Management/Business Policy International Symposium.

Title:	Three Conceptions of Strategy: Comparisons and Integration
Investigator:	Roger Evered, Associate Professor of Administrative Sciences
Sponsor:	NPS Foundation Research Program
Objectives:	To systematically contract the three conceptualizations of strategy in the three fields of Business/Corporate, Military/ Diplomatic and Futures Research / Futuristics. The purpose is to enable each of these three fields to benefit from the ways in which the two other fields frame their strategy concepts, and to seek ways of synthesizing the three conceptual frameworks.
Publications:	Roger D. Evered, "Contrasting Conceptions of Strategy," NPS Technical Report, NPS54-81-021TR, December 1981. Roger D. Evered, "Just What is Strategy: Three Contrasting Concepts," Long Range Planning Vol. 16 No. 3 Forthcoming.
Conference Presentation:	Roger D. Evered, "Contrasting Conceptions of Strategy," Non Traditional Approaches to Policy Research, University State of California, Los Angeles, November 1981.

Title: Career Transition Agenda: Identifying What is Accomplished in Adapting to a New Job (part 2 of a 2-part project)

Investigator: Meryl Reis Louis, Associate Professor of Management, Administrative Sciences Department

Sponsors: The Research Board, The University of Illinois, Urbana-Champaign (8-78-6/79)
NPS Foundation Research Program

Objective: This study is part of a continuing research program, the overall aims of which are to expand our understandings of career transitions and the sense-making processes by which newcomers cope with their experiences. The current phase of the research was designed to identify fundamental tasks which newcomers accomplish in completing career transitions.

Summary: To date the research has resulted in the formulation of: 1) a model of cognitive processes by which individuals cope with transition experiences; 2) a conceptual framework distinguishing among features of transition experiences; 3) a typology of career transition situations; 4) an agenda of fundamental career transition tasks; 5) a mapping of typical resources and strategies available to newcomers for accomplishing fundamental transition tasks. In addition, cultural aspects of organizational life relevant to newcomers have been described, as have more general aspects of culture in organizational settings.

Publications: Meryl Louis, "Managing Career Transitions: A Missing Link in Career Development," Organizational Dynamics, Spring 1982, 68-77.

Meryl Louis, "A Cultural Perspective on Organizations," Human Systems Management, Vol. 2 No. 4, December 1981, 246-258.

Book review of Sociological Paradigms and Organizational Analyses, by Gibson Burrell and Gareth Morgan, Forthcoming in Administrative Science Quarterly, March 1983.

Conference Presentations: Meryl Louis, "Career Transitions and Coping with Life Events," NATO Conference on Role Transitions, Madison, Wisconsin, September 1982, Co-authored with Marc Sokol.

Meryl Louis, "A Sense-Making Problematique in the Organizational Sciences," International Congress of Applied Psychology, Edinburgh, July 1982.

Meryl Louis, "Toward a System of Inquiry on Organizational Culture," An invited address to the Western Academy of Management, Colorado Springs, April 1982.

Meryl Louis, "Useful Knowledge and Knowledge Use: Toward Explicit Meanings," Useful Knowledge, University of Pittsburgh, October 1982.

Title: Should Multinational Organizations Adapt Their Budgeting and Control Practices to the Cultures of Their Hosts?

Investigator: Solange Perret, Assistant Professor of Administrative Sciences

Sponsor: NPS Foundation Research Program

Objective: To answer two interrelated questions: "Can U.S. management practices be successfully exported to culturally different organizations?" or "Is the performance of the foreign operations related to the development of new sets of practices more compatible with the cultures of both the parent and the hosts?" This research is part of an on-going research on cross-cultural issues in management, particularly on the issues created by cultural differences for the implementation of effective controls in multinational organizations. The ultimate objective is to develop a model for designing effective control systems given the cultural differences existing in a given organization.

Summary: The research could not be completed as research sites could not be obtained within the time available in the financial year 1981-1982. Completion is planned by the Summer of 1983. The work accomplished in 1981-1982 is as follows:

-Extensive literature search in the fields of accounting, anthropology, psychology, sociology, and management.

-Improvement of existing instruments and identification of new instruments to measure culture and budgeting behavior.

-Identification of improved statistical methods of analysis.

Publications: S. Perret, "The Meaning of Time," in progress.

S. Perret, "Cross-Cultural Issues in Management," in progress.

Title:	An Economic Model of Careerist Retention
Investigator:	George Thomas, Adjunct Professor of Economics, Department of Administrative Sciences
Sponsor:	NPS Foundation Research Program
Objective:	To develop economic models of careerist retention behavior that have predictive utility.
Summary:	Regression models were constructed to predict changes in reenlistment rates among groups of Navy ratings by using economic factors as explanatory variables. Unemployment was universally shown to be a much more important explanatory variable than pay. Results have implications for the cost-effectiveness of granting across the board pay inducements to increase military supply.
Publication:	Shu Liao and George Thomas, "Economic Factors and the Retention of Military Careerists," in progress.
Conference Presentation:	Shu Liao and George Thomas, "Retention Modeling by Occupation," Joint National Operations Research Society of America/The Institute of Management Sciences Meeting, Chicago, IL, April 1983.
Thesis Directed:	S. L. Christensen, "A Multivariate Analysis of the Determinants of Navy Enlisted Attrition," Master's Thesis, December 1982.

Title: U.S. Coal Resources and Defense Strategy: A Preliminary Investigation (1981-82)

Investigators: David Whipple, Associate Professor of Administrative Sciences Department, Dan Boger, Assistant Professor of Administrative Sciences Department, Jack LaPatra, Adjunct Professor of Administrative Sciences Department

Sponser: NPS Foundation Research Program

Objective: The overall objectives of this portion of this long term research project are: to model the present market structure of the U.S. coal industry; to identify the major relationships and possible scenarios which will affect the long term equilibrium demand for coal from U.S. sources; to estimate/forecast long term (2000) coal prices and production levels based on identifiable domestic and export demand; to estimate the role which U.S. coal supplies could play in fulfilling the long term energy needs of South Korea; to derive market-based federal policy initiatives which could facilitate the increasing dependence of Korea on U.S. coal; and to attempt some initial extrapolations to policies which would increase other such allied nation dependence.

Summary: The United States is rich in coal resources. However, in the past these coal resources have been of only marginal interest because of the relative availability and economy associated with petroleum and natural gas. When the Organization of Petroleum Exporting Countries (OPEC) acted to dramatically increase the price of oil and to demonstrate that its availability was subject to significant non-market manipulation, coal became a much more attractive energy source from both an economic and a political point of view. In particular, since the Oil Embargo the United States has become painfully aware of the extent to which the dependence of allied nations on foreign sources of energy resources can impinge upon the degree of international allied commitment to support U.S. diplomatic and defense efforts. The hypothesis underlying the present proposal is that a judicious policy of relatively passive support for the development of the U.S. coal resource and the adoption of an aggressive international marketing strategy for coal may lead over time to a substitution of both domestic and allied nation energy market reliance on the U.S. and thus may foster a stronger overall defense posture.

We have been fortunate enough to obtain a data base for the U.S. coal supply and demand sectors which is suited to analysis of this possibility. Its characteristics include estimation of the quantity of coal resources by U.S. supply region and various geologic parameters as well as forecasts of the cost mining in the year 2000 time period. We are continuing our efforts to estimate the possibility of substituting U.S. coal for present exogenous energy sources in the long term future of South Korea, given its energy plans, present and forecast supply sources, and the range of possible export prices for the various U.S. coals in the year 2000. The assessment of the Korean energy future is complete (see Mr. Cha's thesis listed in the Thesis section below).

We expect to submit a technical paper to the Journal of Energy and Development and a policy paper to the Journal of Public Policy Analysis and Management in the Spring.

Thesis Directed:

Jin Seob Cha, "An Assessment of the Role of Coal in the Long-Term Energy Plan for Korea," Master's Thesis, March 1982.

DEPARTMENT

OF

OPERATIONS RESEARCH

Title:	Target Motion Analysis
Investigator:	R. N. Forrest, Professor of Operations Research and Chairman ASW Academic Group
Sponsor:	NPS Foundation Research Program
Objective:	To develop a single leg bearings-only target motion analysis procedure.
Summary:	A procedure was developed and is described in the publication listed below.
Publications:	R. N. Forrest, "A Target Motion Analysis Procedure," NPS Technical Report, NPS71-81-003, October 1981.

Title:	Some Statistical Problems in Applied Probability
Investigator:	P. A. Jacobs, Associate Professor of Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	To investigate and model a profile of sea ice cover in the Southern Beaufort Sea that was obtained by the submarine USS GURNARD in April 1976 using a narrow beam upward-looking sonar.
Summary:	Arctic Sea ice behavior, particularly roughness and ridging patterns above and below the surface of the ocean is of scientific interest to oceanographers and geologists. It is also of potential interest to those conducting military operations in the Arctic, and to those exploring for petroleum and other minerals. This pilot study investigated the distribution of the depths of keels (large protuberances of ice beneath the sea surface) and of the distances between relatively deep keels. The data suggest that an exponential-like but not precisely exponential model may well represent the data: the simple exponential model tends to underestimate the distances between keels and the extreme keel depths. The methods utilized are those of exploratory data analysis and of fitting "sculptured exponential" distributions.
Publication:	D. P. Gaver and P. A. Jacobs, "Data Analysis and Modeling of Arctic Sea Ice Subsurface Roughness--A Summary," Signal Processing in the Ocean Environment, forthcoming.
Conference Presentation:	D. P. Gaver and P. A. Jacobs, "Data Analysis and Modeling of Arctic Sea Ice Subsurface Roughness," ONR Workshop on Signal Processing in the Ocean Environment, Annapolis, May 1982.

Title: Dual Screen Interactive Time Series Facility

Investigator: P. A. W. Lewis, Professor of Operations Research and Statistics

Sponsor: NPS Foundation Research Program

Objective: To get GRAFSTAT2 running on the NPS computing facility, examine its utility for handling large data sets in our computing environment and subsequently implement applications packages in GRAFSTAT2 for time series analysis, multiple time series analysis and point process analysis.

Summary: A first version of the experimental IBM APL program GRAFSTAT2 was installed on a test-bed basis at the Naval Postgraduate School in January of 1982 and an updated version in October 1982. A greatly enhanced version GRAFSTAT3 is expected in February 1983, incorporating suggestions from our experience with the package. On our side, with the help of L. Uribe, we have developed an APL workspace called TSERIES containing most of the common time series routines.

With GRAFSTAT2 and TSERIES we were able to do in four hours an analysis of wind speed data from Ship PAPA. The same analysis took a Ph.D. student (D. K. Hugus) six months to do on the batch facility with the Versatec plotter. This time series facility is now being used to analyze ten years of temperature data from Big Sur (in conjunction with Oceanography Ph.D. student, L. Breaker) and to analyze profiles of sea temperature and salinity data taken by the Oceanography Department.

Publication: P. A. W. Lewis, "An APL Workspace HOWTSERIES," NPS Technical Report, forthcoming.

Title:	Myopic Sequential Testing Procedures for Greatest Mean Selection
Investigator:	Alan Washburn, Professor of Operations Research
Sponsor:	NPS Foundation Research Program
Objective:	To investigate the efficiency of myopic as compared to optimal testing procedures.
Summary:	Myopic procedures were tested in two problems: selecting the component type with the greatest reliability, and selecting the category with the greatest mean using noisy tests. The myopic procedure is nearly optimal for the first problem, and is more efficient than other procedures for the second. Comparisons were made by computer simulation.
Publication:	A. Washburn, "Bayesian, Sequential Methods for Selecting the Greatest Mean", Journal of the American Statistical Association, submitted September 1982.

DEPARTMENT

OF

NATIONAL SECURITY AFFAIRS

Title: The Role of Congress in Defense Policy

Investigator: E. J. Laurance, Associate Professor of National Security Affairs

Sponsor: NPS Foundation Research Program

Objective: To update the indicators of the Congressional role in defense policy which were developed in previous work of investigator (e.g. number and type of committee staffs, quantity of hearings, budgetary, decisions by each committee, floor debate, etc.).

To describe and explain the organizational and behavioral characteristics at DoD-Congressional relations.

To assess the impact of the 1974 Congressional Budget and Impoundment Control Act on the defense budget process.

Summary: Some examples of preliminary results include the following: a statistical analysis of roll-call votes reveals a decided decrease in the anti-defense bloc which prevailed from 1969 to 1974; committee action continues to be increasingly strategic in nature; the Congressional Budget office has achieved its stated goal of independent analysis but only in structural issues such as personnel matters; the new budget process has failed to change the line-item orientation of Congress; the micro-management criticism of Congress is exaggerated.

Conference Presentation: As a result of this research and the preliminary results, the investigator has been given a contract by the Roosevelt Center for American Policy Studies to complete a major manuscript for a June 1983 conference in Washington. Government officials and private experts will attend. The aim of the conference is the production of strategies to improve the defense budgetary process.

Title:	The Role of the Armed Forces in Contemporary Asian Societies
Investigator:	E. A. Olsen, Associate Professor of National Security Affairs
Sponsor:	NPS Foundation Research Program
Objective:	To examine the political, economic, and cultural roles of the armed forces in eighteen Asian countries.
Summary:	The investigator prepared a paper on the societal roles of the ROK armed forces, using guidelines he devised as a thematic framework. The same framework was utilized by 17 other Asian studies specialists in preparing their papers for presentation at a NPS-sponsored conference on this topic in August. The papers and an assessment synthesizing their findings into an overview of the roles of Asian armed forces is being prepared.
Publications:	A conference report is being prepared. The papers are being edited and revised for publication in 1983 by Duke University Press, forthcoming.

DEPARTMENT

OF

PHYSICS

Title: Bismuth Germanate Gamma Detector Development

Investigator: Fred R. Buskirk, Professor of Physics

Sponsor: NPS Foundation Research Program

Objective: This project was aimed toward improving the performance of Bismuth Germanate scintillation counters. An initial goal was to improve resolution, reasoning that poor resolution and low signal were caused by the high index of refraction of BGO relative to glass of the photomultiplier. Various treatments of the interface produced no improvement.

Summary: One result which was observed was improved resolution of a broken crystal relative to the original. This improvement could be associated with non-uniformity of the original crystal, or with the diffuse internal reflection from the broken surface.

The most surprising and positive result concerned radiation resistance of BGO. One crystal was subjected to increasingly large bursts from the 100 MeV electron beam of the Linac. One NaI crystal cracked under this treatment but BGO functioned and emitted light during exposure. After exposure the only damage interfering with its performance was associated with activating the Bi and Ge.

This suggests that BGO has two new applications

(a) a gamma detector which is usable after a large blast.
(b) a beam monitor for electron beams in FEL or particle beam accelerators.

Theses Directed: R. R. Cooke, "Scintillation Analysis of Gamma Radiation with Crystals of Bismuth Germanate", Master's Thesis, October 1982.

W. A. Fisher, "Instrumental Photon Activation Analysis Using the Linear Accelerator at the Naval Postgraudate School", Master's Thesis, October 1982.

Title:	Laboratory "Start-up" Grant
Investigator:	S. L. Garrett, Assistant Professor of Physics
Sponsor:	NPS Foundation Research Program
Objective:	To plan and equip a modern laboratory facility for research in acoustics by obtaining necessary instrumentation and computers.
Summary:	Over 51K$ was spent to equip three laboratories with the most advanced general laboratory instrumentation and automated data acquisition and analysis systems. To augment the NPS Foundation Research Program funding, research proposals were written and submitted to: (1)ONR for research in physical acoustics (funded 7 June 82), (2) NPS Foundation for Postdoctoral support (approved 16 June 82), (3) Research Corporation for support of low temperature acoustics (pending), and (4) N.S.F. for low temperature acoustics (pending).
Theses Directed:	D. Conte, "Computer Controlled Acquisition and Analysis of Sound Resonance Measurements", Master's Thesis, December 1982. L. Skorenek, "Automated Measurement of SONAR Transducer Equivalent Electrical Parameters", Master's Thesis, December 1982.

Title: Classical Trajectory Studies of Low Energy Ion Impact Mechanisms on Clean and Reacted Single Crystal Surfaces

Investigators: Don E. Harrison, Jr., Professor of Physics, with Roger P. Webb, Postdoctoral Associate

Sponsor: National Science Foundation and NPS Foundation Research Program

Objectives: Continue study of the effects produced when ions bombard clean and chemically reacted single crystal metal surfaces to understand mechanisms and coordinate with experimental investigations.

Summary: Classical trajectory simulations have developed to the point that it is feasible to model the cascade produced by an ion impact event. The ability to follow each individual atom in the cascade leads naturally to pictorial interpretations of a single sputtering event. Statistical analysis of data produces numbers which can be directly compared to the experimental data. The model computations are done using single crystal targets oriented to expose the low index surfaces. Research effort this year has establised that low keV ion bombardment produces pits in metal surfaces, indicating that there is no essential difference between the linear cascade and high energy density regimes of statistical sputtering theory. Very low energy sputtering has been studied and the lowest energy sputtering mechanisms identified. A new version of the program has been developed whose run time increases as N, the number of atoms in the target, rather than N^2 as in the past. A program has been written to study pit formation and ion beam mixing. Another program has been written to study very low energy ion scattering. The work will be done in conjunction with investigators from SRI and the FOM Laboratory in Amsterdam. Studies of displacement from propagation were completed.

Publications:

R. P. Webb and D. E. Harrison, Jr., "Near-Threshold Sputtering Mechanisms from a Computer Simulation of Argon Bombarded Clean and Oxygen-Reacted Copper Single Crystals," Journal of Applied Physics, 53(7), 5243, 1982.

D. E. Harrison, Jr. and R. P. Webb, "A Molecular Dynamics Simulation Study of the Influence of the Lattice Atom Potential Function Upon Atom Ejection Processes," Journal of Applied Physics, 53(6), 4193, 1982.

DEPARTMENT

OF

ELECTRICAL ENGINEERING

Title: Millimeter Wave Network Analyzer

Investigator: Jeffrey B. Knorr, Professor of Electrical Engineering

Sponsor: NPS Foundation Research Program

Objective: To construct an automated millimeter wave scalar network analyzer system and to mathematically model the system response.

Summary: A mathematical model of a scalar network analyzer has been developed using scattering parameters. A millimeter wave analyzer system has been constructed and the experimentally observed behavior has been found to agree with that predicted by the model. Optimum procedures for calibrating the system and for establishing bounds on measurement error have been determined. The relationship between system performance and component specifications has been carefully established. System software development work is currently in progress.

Publication: J. B. Knorr, "Scattering Analysis of a Millimeter Wave Scalar Network Analyzer", in progress.

Thesis Directed: Charles Shultheis, "A Model for a Millimeter Wave Network Analyzer Test Set", Masters Thesis, June 1982.

Title: Computer Region Segmentation on Aerial Photographs

Investigator: C. H. Lee, Associate Professor of Electrical Engineering

Sponsor: NPS Foundation Research Program

Objective: The objective of this work is to improve the performance of existing algorithms for region segmentation applied to high resolution aerial photographs.

Summary: A Recursive Splitting method at hierarchical scopic levels will be developed and implemented. This requires a special data structures constructed in the memory space of the computer. To evaluate this scheme, it is necessary to implement this structure in a virtual memory machine. The iteration criterion in the algorithm will include diagonal profile consideration. Special problems caused by discontinuous boundaries from splitting at different levels will be solved by adjacency propagation of thresholds".

A digital aerial photograph of 5000 x 5000 resolution will be used as a baseline data set. The work is divided into the following phases:

Phase 1: Prepare and reformat the data set

Phase 2: Develop software on the host for the COMTAL display system

Phase 3: Implement the hierarchical scopic level structure

Phase 4: Implement the output data structure to resolve the boundary discontinuity problem

Phase 5: Experiment and compare the proposed algorithm with other algorithms for region segmentation

During the period from 1 June to 30 September 1982, Phase 1 and Phase 2 were accomplished.

Publications: C. H. Lee, "Iterative Region Segmentation", Proceedings of Image Processing and Pattern Recognition Conference, 1982.

C. H. Lee, "Interpolation of Weighted Average Samples Using B-Spline Functions", in progress for IEEE Proceedings.

Title: Cybernetic Models of Military C^3I Systems

Investigators: P. H. Moose, Associate Professor of Electrical Engineering, K. E. Woehler, Professor of Physics

Sponsor: NPS Foundation Research Program

Objective: Development of a possible conceptual basis for defining and evaluating military C^3I systems is the long term objective. The immediate objective is to explore two such conceptual models:
a) A highly aggregate Lanchester type model in which military forces and information are treated as assets subject to gain and attrition processes. The equilibria and their stability are to be investigated.
b) A continuum theory of an information and command flow hierarchy controlling an interacting military force environment is to be developed with the aim to find useful "structure functions" of C^3I systems for which their influence on system performance can be studied.

Summary: Under item a) above the dynamics of the interactions between forces and information has been modeled by non-linear evolution equations. The attrition functions are approximated by polynomials of second degree. The various terms are identified with C^3I, counter C^3, intelligence and firepower of the forces. At least one of the possible stationary points is easily determined. Linear stability analysis shows this equilibrium to be environmentally unstable; that is, a smooth variation in one of the parameters (here the C^3I effectiveness) can change the stagnant conflict into one with a decisive outcome. In the case of stable equilibrium a force multiplication ratio is defined by the ratio of the force replenishment rates. This ratio from the C^3I, counter C^3, intelligence and firepower parameters of the model gives a quantitative measure of effectiveness for the value of C^3 to the fighting forces.

Under item b) a system has been constructed that mimics many aspects of a hierarchical C^3I system. The environment with which the system interacts and about which it attempts to obtain knowledge is characterized by a multidimensional state vector E(k). The system structure is governed by 13 structure functions which regulate the method of obtaining and distributing knowledge about the system and reacting to changes in the environment through a goal and command structure. The model is mathematically a system of coupled integrodifferential equations for the functions characterizing the state of knowledge and the command state.

The model needs to be programmed for computer calculations to study system responses to modifications in E(k).

Publication: P. H. Moose, "Dynamics of Modern Military Conflicts," NPS Progress Report, NPS62-82-047PR, October 1982.

Conference Presentation: P. H. Moose, "Extensions of Lanchester Equations", ONR/MIT C^3 Workshop, NPS, Monterey, CA August 1982.

Thesis Directed: T. W. Fox, "An Investigation of the Dynamic Model of Modern Military Conflict", Master's Thesis, March 1982.

Title: Digital Signal Processing - I

Investigators: S. R. Parker, Professor of Electrical Engineering, and Y. C. Lim, NRC Postdoctoral Research Associate

Sponsor: NPS Foundation Research Program

Objective: To study techniques for the design and implementation of digital signal processing algorithms.

Summary: During this period several important results have been achieved. An efficient algorithm for the design of finite impulse response (FIR) digital filters with finite coefficient word length has been developed, using a minimum least mean squares error criteria between the performance of the filter and the specification. This algorithm allows for the design of filters of order well beyond other approaches by a factor of three for the same computer time. Other work includes the synthesis of lattice parameter digital filters, the design of FIR for a finite power-of-two coefficient field, and decimation techniques for the efficient implementation of digital filters using microprocessors. These contributions are discussed in detail in the publications which follow.

Publications:

Y. C. Lim and S. R. Parker, "Discrete Coefficient FIR Digital Filter Design Based on an LMS Criteria," IEEE Transactions on Circuits and Systems, to appear October 1983.

Y. C. Lim and S. R. Parker, "Efficient FIR Filter Implementation Using Microprocessors," IEEE Transactions on Acoustics, Speech and Signal Processing submitted 1982.

Y. C. Lim, S. R. Parker and A. Constantinides, "Finite Wordlength FIR Filter Design Using Integer Programming Over a Discrete Coefficient Space," IEEE Transactions on Acoustics, Speech and Signal Processing Vol 30, No. 4, August 1982, pp. 661-64.

Y. C. Lim and S. R. Parker, "FIR Filter Design Over a Discrete Powers-of-Two Coefficient Space," IEEE Transactions on Acoustics, Speech and Signal Processing June 1983.

Y. C. Lim and S. R. Parker, "On the Synthesis of Lattice Parameter Digital Filters," IEEE Transactions on Circuits and Systems, submitted 1982.

Conference Presentations:

Y. C. Lim and S. R. Parker, "Digital Lattice Filter Design Using a Frequency Domain Criteria," Proceedings of IEEE International Conference on Acoustics, Speech and Signal Processing, Paris 1982, pp 282-5.

Y. C. Lim and S. R. Parker, "A Discrete Coefficient FIR Digital Filter Design Based on an LMS Criteria," Proceedings IEEE International Symposium on Circuits and Systems, Rome 1982, pp. 296-299.

Y. C. Lim and S. R. Parker, "On the Synthesis of Lattice Parameter Digital Filters," IEEE International Conference on Acoustics, Speech and Signal Processing, accepted for 1983.

Y. C. Lim and S. R. Parker, "Efficient FIR Filter Implementation Using Microprocessors," IEEE International Converence on Acoustics, Speech and Signal Processing, accepted for 1983.

Y. C. Lim, S. R. Parker and A. Kayran, "A Decimation Technique for Optimal Data Transfer in One and Two-Dimensional FIR Digital Filter Implementations," IEEE International Symposium on Circuits and Systems, accepted for 1983.

Y. C. Lim and S. R. Parker, "Filter Design Over a Discrete Powers-of-Two Coefficient Space," IEEE International Symposium on Circuits and Systems, accepted for 1983.

Title: Digital Signal Processing - II

Investigators: S. R. Parker, Professor of Electrical Engineering, and J. J. Thomas, NRC Postdoctoral Research Associate

Sponsor: NPS Foundation Research Program

Objective: To study techniques for the design and implementation of digital signal processing algorithms.

Summary: This research has concentrated on two areas; the modeling and identification of nonlinear discrete time systems and the use of finite field arithmetic for the implementation of digital algorithms.

The discrete nonlinear moving average identification problem has been shown to be contained within a two dimensional impulse response solution, where convolution is applied in the nonlinear dimension regardless of the order of the nonlinearity. This approach has been generalized using tensor notation and operations which are readily programmed. Also the use of the DFT for Volterra kernel identification, separability tests for cascaded linear/nonlinear subsystems, stability test, and spectral analysis have been considered.

Arithmetic operations defined over a finite field, GF(P) have the advantage of exact calculations. It has been shown that implementation of modular arithmetic can be realized with minimal effort in already existing hardware. In addition, operations over the ring of integers Mod p^N, N>1, $GF(p^2)$ and the ring Mod p^2 can be easily formulated using the operations over GF(P). Mathematical operations of this type are especially useful in algorithms or processes which are unstable due to roundoff or truncation.

In addition to the publications which follow five additional papers have been prepared and submitted for publication.

Publications: S. R. Parker, L. Mayoral and J. J. Thomas, "An Adaptive Kalman Identifier and Its Application to Linear and Nonlinear ARMA Modeling," Proceedings of the 16th Princeton Conference on Information Sciences and Systems, March 1982, 6 pages.

S. R. Parker and J. J. Thomas, "Analysis and Identification of Discrete Nonlinear Moving Average Systems," submitted to IEEE Transactions on Circuits and Systems, Nov. 1982.

J. J. Thomas and S. R. Parker, "Modeling Nonlinear Systems with a Discrete Volterra Series Expansion," in Proceedings of 25th Midwest Symposium on Circuits and Systems, Michigan Technology University, August 1982.

DEPARTMENT

OF

METEOROLOGY

Title:	Synoptic Studies of Cold Surge Initiation
Investigators:	Chih-Pei Chang, Professor of Meteorology and James S. Boyle, NRC Postdoctoral Research Associate
Sponsor:	NPS Foundation Research Program
Objective:	To study the behavior of midlatitude circulations before, during and after cold surges in the Asian winter monsoon.
Summary:	A detailed synoptic study of the December 1974 and December 1978 data are carried out to study the sequence of events in the extratropical latitudes during East Asian cold surge periods. It was found that the most important large scale system is the upper tropospheric long wave ridge-trough pattern over East Asia where the ridge supports the surface Mongolian high through continued cold air advection. The major difference in the ridge-trough between the two Decembers causes considerable differences in the surge activities. Secondary circulations were calculated to show the possible important mechanisms for instigating the cold surges in the subtropical latitudes.
Conference Presentation:	J. S. Boyle, "Synoptic Study of the Initiation of Surges", Winter MONEX Workshop, Monterey, CA, June 1982, 14-15.

Title:	Maritime Cyclones
Investigator:	R. L. Elsberry, Professor of Meteorology
Sponsor:	NPS Foundation Research Program
Objective:	To understand and improve predictions of smaller scale cyclones that affect fleet operations over the mid-latitude oceans.
Summary:	This is the initial effort of a wide-ranging project treating cyclones over the oceans. A multi-year research project funded by NASA has resulted from this effort and the atmospheric-ocean coupling work will be proposed to ONR and NAVAIR.
Publications:	R. L. Elsberry, R. L. Haney, R. T. Williams, R. S. Bogart, H. D. Hamilton and E. F. Hinson, "Ocean-Troposphere-Stratosphere Forecast System," Naval Environmental Prediction Research Facility Contract Report, NEPRF CR 82-04, 1982. R. L. Elsberry, S. A. Sandgathe and F. J. Winninghoff, "Short-Term Oceanic Response Predicted by a Mixed Layer Model Forced with a Global Sector Atmospheric Model," submitted to Journal of Physical Oceanography, 1982.

Title:	Diagnostics of Oceanic Extratropical Cyclones
Investigator:	C. H. Wash, Assistant Professor of Meteorology
Sponsor:	NPS Foundation Research Program
Objective:	To transfer and develop a variety of limited-area diagnostic programs for the study of observed and numerically-simulated extratropical cyclone studies and to apply these techniques to the study of oceanic cyclogenesis.
Summary:	During FY82 circulation and vorticity budget programs with output displays were completed and a circulation and angular momentum study of observed east-coast cyclogenesis conducted using data from the First Global GARP Experiment. Also the diagnostics were applied to a numerical simulation of open-ocean cyclogenesis by a version of the NOGAPS operational model.
Publication:	C. Wash with L. Uccellini, P. Kocin, R. Petersen and K. Brill, "The President's Day Cyclone, 18-19 February 1979. Part I: An Analysis of Subtropical and Low-Level Jet Streaks Prior to Cyclogenesis," Monthly Weather Review, forthcoming.
Conference Presentations:	C. Wash with L. Uccellini and P. Kocin, "An Analysis of the LFM-II Simulations of the President's Day Cyclone, February 18-19, 1979," Fifth Conference on Numerical Weather Prediction, Monterey, CA, November 2-6, 1981.
	C. Wash, P. Conant and D. Roman, "Quasi-Lagrangian Mass, Angular Momentum and Circulation Budgets for the President's Day Cyclone, 18-21 February 1979," Ninth Conference on Weather Forecasting and Analysis, Seattle, WA, June 28-July 1, 1982.

DEPARTMENT

OF

AERONAUTICS

Title:	Compressor Tip Clearance Effects
Investigator:	Dr. R. P. Shreeve, Director, Turbopropulsion Laborator, Department of Aeronautics
Sponsor:	NPS Foundation Research Program
Objective:	To investigate the effects of changes in tip clearance on the performance of and flow fields within a multistage axial compressor with a view to proposing an improvement in the usual design procedure which ignores the gap.
Summary:	A 36 inch O.D. low speed three stage axial compressor having a 7.2 inch cylindrical flow path has been fitted with a single stage of "symmetrical" blading and first measurements of the performance map and internal flow profiles have obtained. Work has concentrated on setting up instrumentation and procedures for the tip clearance study. The flow from the IGV's was found to be underturned over the outer 30% of the blade in the presence of a thick inlet boundary layer. Corrections, and control of the boundary layer are being evaluated before additional stages are added and tip clearance variations are effected. (Procedures for blading manufacture and machining for tip gap control were developed in early phases of the study.)
Publication:	J. L. Waddell, "Multi-stage Compressor--Flow Losses in Throttle Screens and Plates," NPS Turbopropulsion Laboratory Technical Note, TPL TN 82-01, February 1982.
Thesis Directed:	J. L. Waddell, "Evaluation of the Performance and Flow in an Axial Compressor," Master's Thesis, June 1982.

Title: Numerical Modeling of the Flow in Transonic Axial Compressors

Investigators: Dr. R. P. Shreeve, Director, Turbopropulsion Laboratory, and S. Eidelman, NRC Postdoctoral Research Associate

Sponsor: NPS Foundation Research Program

Objective: To develop a computer code which solves efficiently and accurately the transonic flow between the blades of a turbocompressor.

Summary: A code, based on the Godunov method, was developed for a body-fitted curvilinear coordinate system with multi-grid capability. In this code, the Euler equations are solved in Cartesian coordinates and Riemann problems are solved in directions normal to the boundaries of the computational mesh. A second variant of the code was developed which uses a new second order accurate method of Collela. Comparison of the predictions of both methods with an analytical solution of the shock wave problem showed good accuracy for both codes. The second order accurate method had very sharp shock wave resolution over only two grid points. Testing the codes on the problem of the flow in a channel with a circular arc "bump" gave good results for the supersonic case. Testing for subsonic and transonic flow is proceeding. Since the approach uses the unsteady equations, the program can be applied with unsteady boundary conditions. A preliminary modeling of the opening of a wave rotor cell showed that it is possible to use the developed program for modeling two-dimensional effects in wave engines.

Publications: S. Eidelman, "A Method of Calculation of the Critical Energy for Direct Initiation of Unconfined Detonation," Combustion Science and Technology, Vol. 44, 1982, p. 444.

S. Eidelman, A. Mathur, R. Shreeve and J. Erwin, "Application of Riemann Problem Solvers to Wave Machine Design," submitted for publication to AIAA Journal, 1982.

Title:	Very High Reaction Turbines
Investigator:	Dr. R. P. Shreeve, Director, Turbopropulsion Laboratory, Department of Aeronautics
Sponsor:	NPS Foundation Research Program
Objective:	To investigate analytically and experimentally the potential of two proposed very high reaction turbines of original design.
Summary:	A turbine concept involving a simple, easily machined rotor geometry has been promoted by Mr. Carlos Fernandez. An analysis was completed of the potential of the prototype geometry and was programmed to allow variation of the available parameters. Plans to test the prototype were not yet realized. The concept may be useful in drive applications from compressed gas energy storage systems. An apparatus to measure static torque of a detonative combustion turbine concept was built and will be tested in coming months.
Thesis Directed:	J. R. Martin, "Evaluation of a High Reaction Supersonic Turbine Concept," Master's Thesis, June 1982.
Patent Application:	S. Eidelman, "Rotary Detonation Engine," applied March 13, 1982, Navy Case Number 65681.

DEPARTMENT

OF

OCEANOGRAPHY

Title: Evaluation of Towed Body Turbulence Measurements

Investigator: T. R. Osborn, Professor of Oceanography

Sponsor: NPS Foundation Research Program

Objective: The objective is to determine the feasibility of using a towed body for oceanic turbulence measurements. Previous open ocean turbulence measurements have been made with a free fall vehicle or from submarines. Our hope is to make horizontal transects with a towed body. Thus we would have data that previously only came from a submarine platform with the simplicity of operation typical of a free fall body.

Summary: A towed body was borrowed from Applied Physics Laboratory/Johns Hopkins University. It was modified slightly for our operation. We locked the control surfaces, smoothed the body by removing various attachments, and increased the roll stability by adding a keel. Our plan was to tow the body not as a depressor, but rather with an almost horizontal cable well behind the surface ship. This approach minimizes the tension in the cable. Field tests were very positive. The work is being continued in 1983 with NORDA Ocean Measurements Program funding.

Title:	Numerical Ocean Circulation Study of the Chukchi Sea
Investigators:	D. C. Smith, IV, Adjunct Professor of Oceanography, R. W. Paquette, Professor of Oceanography, and R. Bourke, Associate Professor of Oceanography
Sponsor:	NPS Foundation Research Program
Objectives:	Summer melting of the ice cover in the Chukchi Sea suggests the oceanic flow is largely dominated by topographic features. An investigation utilizing a numerical model with variable flow and topography was undertaken to test this hypothesis.
Summary:	A two layer semi-implicit numerical model was adapted for use in a dynamical study of circulation in the Chukchi Sea. Several boundary conditions were tested for modelling of northward outflow. A range of experiments with variable inflow vertical structure was conducted.

Title: Implementation of Acoustic Doppler System Profiler

Investigators: E. B. Thornton, Professor of Oceanography, and T. P. Stanton, Adjunct Professor of Oceanography

Sponsor: NPS Foundation Research Program

Objective: The objectives of this research are to develop the Amatek Straza ADSP, integrate it with ocean measurements from the ACANIA Data Acquisition System (DAS) and investigate the response of the upper ocean currents to the wind stress at the surface.

Summary: Software was written on an HP 9826 to acquire, process and record the ADSP data stream, and interact with the R/V ACANIA Data Acquisition System computer. Algorithms to unpack the ADSP data, compensate for pitch and roll and resolve absolute velocity components are written for post-processing on the NPS mainframe. Methods have been developed to display these data together with DAS logged surface information and CTD/XBT profiles. A successful three day cruise was conducted to use the acoustic doppler profiler system (ADSP) to measure wind induced shear currents in the upper hundred meters of the ocean. Absolute velocity measurements were acquired using mini-ranger navigation. Wind stress is inferred from wind velocity measurements. Maximum windspeeds exceeded 20 m/s during the experiment. The density field was monitored by a two-yowed CTD. The measurements are compared with a time dependent Ekman upper boundary layer model giving reasonable results.

Publications:

E. B. Thornton and T. P. Stanton, "Absolute Current Measurements using a Ship Mounted Acoustic Doppler Speed Profiler," NPS Technical Report, in progress.

E. B. Thronton and T. P. Stanton, "Current Velocity Measurements through the Mixed Layer," Journal of Geophysical Research, in progress.

Title: Trench Wave Dynamics

Investigator: A. J. Willmott, Assistant Professor of Oceanography

Sponsor: NPS Foundation Research Program

Objective: To examine the dynamics of freely propagating trench waves on a mid-latitude beta-plane using analytic techniques. For different Pacific Ocean trenches the period and wavelength for which the waves can no longer be coastally trapped are calculated.

Summary: Dispersion curves for trapped trench waves are calculated for the Japan, Juril and Peru trenches. The hyperbola $\omega_c = \beta(1 - \sin \nu)/2k_c$ partitions wave number-frequency space. The region bounded by the coordinate axes and the critical curve corresponds to the continuum of leaky trench waves. The leaky waves take the form of linear Rossby waves in the ocean interior. Therefore the generation of trench waves may ultimately lead to another source of barostropic Rossby waves in the Pacific Ocean.

Publications: A. J. Willmott, and A. A. Bird, "Freely Propagating Trench Waves on a Beta-plane," Submitted to Journal of Physical Oceanography.

A. J. Willmott, and A. A. Bird, "Freely Propagating Trench Waves on a Beta-plane," Ocean Modelling. Forthcoming.

Conference Presentations: A. J. Willmott, "Freely Propagating Trench Waves on a Beta-plane," 16th Annual Congress of CMOS, 26-28 May, 1982.

A. J. Willmott, "Freely Propagating Trench Waves on a Beta-plane," JOA, Halifax, Canada, 2-13 August, 1982.

DEPARTMENT

OF

MECHANICAL ENGINEERING

Title:	Contact Problems in Stress Analysis
Investigator:	Gilles Cantin, Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	Formulate solution methods for a class of fictitious material elements for contact problems with or without friction.
Summary:	All conditions have been established to satisfy stress boundary conditions for contact problems. Numerical results are very good, the formulation of a new class of a fictitous contact element has also been completed. Implementation of this theory in a computer code was contemplated using the GIFTS System. As a part of this project, the GIFTS code was installed in the VAX system of the Computer Science Department. A low cost terminal was purchased for this phase of the work and the terminal retrofitted for Graphics representation. The work continues in fiscal year 1983

Title: Elevated Temperature Fatigue of Alloys used in Propulsion Systems

Investigator: Kenneth D. Challenger, Associate Professor of Mechanical Engineering

Sponsor: NPS Foundation Research Program

Objective: To discover the damage mechanisms responsible for fatigue failures at elevated temperatures.

Summary: The Central Electric Research Laboratories, Leatherhead, England agreed to provide their vacuum fatigue testing facilities for the fourth quarter of AY 81-82 to me for this research. Thus, I spent three months in England using their equipment for this research. The use of vacuum testing was critical to conclusively eliminating the effects of oxidation on fatigue at elevated temperatures. It is now conclusively shown that the major damage mechanism for steam generator alloys is an interaction between oxidation and fatigue, not an interaction between creep and fatigue as was believed to be the case for many years. The elevated temperature design community of the ASME must now revise their methods of calculating fatigue damage for these alloys.

Publications: K. D. Challenger and P. G. Vining, "The Effects of Hold Time in the Fatigue Crack Growth rate of $2^{1/4}$ Cr - 1Mo Steel," ASME Journal of Engineering Materials and Technology, forthcoming.

Title:	Experimental Investigation of the Fluid Mechanics of Bouyant Liquid Plumes
Investigator:	William G. Culbreth, Assistant Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To investigate the velocity distributions in and around heated jets of water introduced into a flowing ambient using a Laser Doppler Velocimeter. Mathematical models of bouyant jets and plumes are to be verified or modified and entrainment coefficients are to be determined.
Summary:	A Laser Doppler Velocimeter has been purchased and interfaced to a computer-based data acquisition system. A transversing mechanism was installed to allow movement of the LDV with respect to the test section. The fluid circuit was constructed to generate the heated jet of liquid at variable flow rates. Testing of the system has taken place and turbulent velocities have been measured and stored by the data acquisition system.

Title:	Liquid Crystal Thermography in Jet-Crossflow Interactions
Investigator:	R. H. Nunn, Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	Investigate the feasibility of the use of liquid crystals for mapping the surface interaction field that results when a jet is injected into a crossing flow.
Summary:	An experimental system was designed and built. Preliminary tests were conducted in which a number of design improvements were suggested. In general, it was shown that liquid crystal thermography can be a unique and useful method for the qualitative analysis of complex flow fields.
Thesis Directed:	M. D. Johnson, "Liquid Crystal Mapping of Jet-Crossflow Interactions," Master's Thesis, December 1981.

Title: Martensitic Transformation in Shape Memory Alloys

Investigator: Jeff Perkins, Associate Professor of Mechanical Engineering

Sponsor: NPS Foundation Research Program and National Science Foundation

Objective: The general objective of the research is to examine the effect of microstructural parameters on martensitic transformation in shape memory alloys.

Summary: Considerable progress has been made in the examination of the effects of microstructural variables, including grain size and dislocation substructure. Effects of transformation kinetics have also been studied in detail.

Publications:

Jeff Perkins, "Ti-Ni and Ti-Ni-X Shape Memory Alloys," Metals Forum, the Journal of the Australasian Institute of Metals, 4(1981), 153-163.

Jeff Perkins, "Shape Memory Behavior and Thermoelastic Martensitic Transformations," Materials Science and Engineering, 51(1981), 181-192.

Jeff Perkins, "Rapid Solidification Effects in Martensitic Cu-Zn-Al Alloys," Metallurgical Transactions 13A(1982), 1367-1372.

Jeff Perkins and W. E. Muesing, "Martensitic Transformation Cycling Effects in Cu-Zn-Al Shape Memory Alloys," Metallurgical Transactions, forthcoming.

Jeff Perkins, "The Microstructure of Rapidly Solidified β-Phase Cu-Zn-Al Alloys," submitted to Metallurgical Transactions.

Jeff Perkins, "Effects of Austenite Microstructure on Martensitic Transformations in Cu-Zn-Al Shape Memory 'Training' in Cu-An-Al Alloys," submitted to Metallurgical Transactions.

Conference Presentations:

Jeff Perkins, "Effects of Austenite Microstructure on Martensitic Transformations in Cu-Zn-Al Shape Memory Alloys," International Conference on Martensite Transformations, Leuven, Belgium, August 1982.

Jeff Perkins, "Transformation Cycling Effects in Martensitic Cu-Zn-Al Shape Memory Alloys," Fall 1982 Meeting of the Metallurgical Society, St. Louis, MO, October 1982.

Theses Directed:

William E. Muesing, "Thermal Martensitic Transformation Cycling in Cu-Zn-Al Shape Memory Alloys," Master's Thesis, March 1982.

Richard O. Sponholz, "An Investigation into the Two-Way Shape Memory Trainability of Polycrystalline Cu-Zn-Al Alloys," Master's Thesis, June 1982.

Title: Reliability-based Analysis of Random High Cycle Fatigue Life

Investigator: Y. S. Shin, Associate Professor of Mechanical Engineering

Sponsor: NPS Foundation Research Program

Objective: To develop the reliability-based analysis method of high-cycle fatigue life under the random vibration enviroments, and to develop a related computer program to evaluate the fatigue life as a probability of survival.

Summary: An extensive literature search for high-cycle fatigue test data was completed and statistical variability of the fatigue damage index at failure was evaluated. As a result, a Weibull distribution function was found to be a best probability model for the critical fatigue damage index. The analytical equations were formulated. A computer program, "FATIGUE", was developed and is operational on NPS-IBM computer. Parametric studies were performed to evaluate the sensitive parameters to fatigue life. The need to develop a fatigue life prediction for the multi-axial state of stress was identified and the efforts have been made to look into the details of fatigue failure criterion.

Publication: Y. S. Shin, "Reliability-based Analysis of Random High-Cycle Fatigue Life," NPS Technical Report, in Progress.

Conference Presentations: Y. S. Shin, "Reliability-based Fatigue Damage Predictions Under Random Vibration Environment," submitted for presentation at the AIAA/ASME/ASCE/AHS 24th Structures, Structural Dynamics, and Materials Conference in Lake Tahoe, Nevada on May 2-4, 1983

Y. S. Shin, and R. W. Lufkins, "Probability Based High-Cycle Fatigue Life Predictions.," Accepted for the presentation at the ASME 4th National Congress on Pressure Vessel and Piping Conference in Portland, Oregon on June 19-24, 1983.

Thesis Directed: R. W. Lufkins, "A High-Cycle Fatigue Life Predictions under the Multiaxial State of Stresses.", Master's Thesis, (To be reported on June, 1983)

Title:	Optimum Design of Torsional Shafts Using Composite Materials
Investigator:	Garret N. Vanderplaats, Associate Professor of Mechanical Engineering
Sponsor:	NPS Foundation Research Program
Objective:	To develop the analytic capability and FORTRAN program for the analysis of shafts made of multi-layered composite materials and couple this to a numerical optimization program to provide a general automated design capability.
Summary:	The program has been developed and demonstrated with the design of isotropic and composite shafts. Two theses have been written as part of this research and a third has directly used the results of this research.
Theses Directed:	Virgilio S. Merced, "Drive Shaft Design Using Numerical Optimization, "Master's Thesis, June 1980. Amhed Onal, "Design of Composite Driveshafts using Nummerical Optimization," Master's Thesis, December 1981. James Hopper, "Probabilistic Design Using Numerical Optimization, "Master's Thesis, October 1982.

APPENDIX I

Summary Title	Investigator	Type Funding
COMPUTER SCIENCE		
Distributed vs. Centralized Database Systems	D. Z. Badal	6.1
Relational Programming	B. J. MacLennan	6.1
Advanced Work on an Algorithm Design Methodology	D. R. Smith	6.1
MATHEMATICS		
Acceleration of Convergence of Iterative Algorithms	M. D. Humphries	6.1
Fundamental Frequencies of Oscillation of an Immersed Elastic Boundary	R. Mendez	6.1
Numerical Modelling of Transonic Flow Past Cascade Blades Via Higher Order Godunov Methods	R. Mendez S. Eidelman	6.1
Numerical Solution of the Interior Neumann Problem Via Vortex Dipoles	R. Mendez	6.1
The Vortex Monopole Algorithm: Representation of Elastic Forces Applied to Incompressible Inviscid Fluids	R. Mendez	6.1
Determination of Frequency Dependent Early-To-Reverberant Sound Ratios Using Ray Tracing Methods	J. Y. Wayman	6.1
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Laboratory "Start-up" Grant	S. L. Garret	6.1
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Digital Signal Processing - II	S. R. Parker J. J. Thomas	6.1
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Synoptic Studies of Cold Surge Initiation	C. -P. Chang J. S. Boyle	6.1
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Diagnostics of Oceanic Extratropical Cyclones	C. H. Wash	6.1
AERONAUTICS		
Compressor Tip Clearance Effects	R. P. Shreeve	6.2

Summary Title	Investigator	Type Funding
Numerical Modeling of Flow in Transonic Axial Compressors	R. P. Shreeve S. Eidelman	6.2
Very High Reaction Turbines	R. P. Shreeve	6.2
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Reliability-based Analysis of Random High Cycle Fatigue Life	Y. S. Shin	6.2
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